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(54) REPRODUCTION DEVICE FOR DISC-FORM RECORD CARRIERS

(71) We, TED BILDPLATTEN AKTIENGESELLSCHAFT AEG-TELEFUNKEN . TELDEC of Hanibuhl 8, Postfach 126, CH—6301 Zug, Switzerland, a Body Corporate organised under the laws of Switzerland, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to a reproduction device for disc-form record carriers with signals stored in grooves or successive turns of a single groove.

The invention seeks to provide a device which makes it possible to influence the scanner in a purposeful manner, during the reproduction of information stored in grooves of a record carrier so that it is possible for example, in the case of reproduction of television signals, to achieve a still picture, a slow motion, a speeded up or even a reverse reproduction.

In accordance with the invention, there is provided a reproduction device for disc-form record carriers having signals stored in a plurality of grooves or in a groove having a plurality of turns, particularly for video disc-form record carriers, said device comprising a carriage which is displaceable during reproduction radially with respect to a record carrier and a scanner resiliently mounted on the carriage and guidable in said groove(s) in the record carrier, wherein means are provided to cause the scanner to jump at right angles to the groove direction into adjacent grooves or groove turns said means including a pulse generator arranged to act on the scanner with a force pulse which when energized serves to lift the scanner from the surface of the record carrier and to move the scanner radially with respect to the record carrier over a predetermined number of ridges formed between the adjacent grooves or groove turns in the record carrier.

Particularly in the case of reproduction of television signals it is necessary that the times when the scanner is displaced be correlated with the picture content. The scanner is caused to be displaced or to "jump" preferably during a gap in the recorded television signal, since then an intermittent drop-out of the signal does not appear disturbing for the viewer. Such a correlation can be generated either by control of the force at "jump" pulses by the drive means for the record carrier, or, if the position of the record carrier on the drive means is not defined, by signals present on the record carrier itself.

Appropriately electrical or magnetic means such as, electromagnets or piezo-ceramic elements can be used for triggering the pulses.

In order to achieve protection of the record carrier, the applied force or pump pulse contains not only a component transverse to the groove direction but a further component opposed to the contact pressure, since in this way the leaving of the groove by the scanner is facilitated.

If devices are provided which make it possible to apply pulses in two force directions, different from each other, perpendicularly to the groove direction, then the jump direction of the scanner can be influenced over broad limits. In order to be able to have good control over the movements of the scanner, it is favourable if the force directions each form an angle of 135° with the direction of the contact force of the scanner acting on the record carrier.

A pulse shaper may be provided which shapes the force pulses to have a steep rising flank and a shallow falling flank. This arrangement provides the possibility of effecting a rapid lifting of the scanner and a retarded

replacement whereby additional protection of the record carrier is effected.

Since, the scanner is not displaced by the resiliency of its mounting but by direct action of the force pulses and in displacing is raised from the record carrier surface, its compliance can be chosen to be very large so that the wear of the record carrier is small and the forces to be applied to displace it by the device in accordance with the invention are small.

In the case of a record carrier with a spiral groove, which contains the signals forming a television picture, the feed speed V_s of the scanner with reference to the record carrier in the radial direction relates to the pulse number per second i and the jump width s according to the formula:

$$v_s = v_o\left[\frac{i \cdot s}{f \cdot b_r} + 1\right],$$

wherein the jump width s depends on the intensity of the pulses applied to the scanner and, according to the direction of the pulses assumes positive or negative value with reference to the groove inclination. v_o represents the normal feed speed, b_r is the groove width and f is the picture reproduction frequency. The drive speed of the holder of the scanner in the radial direction with respect to the record carrier is adapted to the feed speed v_s by suitable means.

In practical tests it has been shown that the effect of the force or jump pulses exerted by an electromagnet on an armature fastened to the movable scanner part is impaired by variations in position, which this movable scanner part and thus the armature during operation, executes as a result of radial and/or sharp height variations of the the record carrier. If, as a result of the magnetically cooperating parts, a force or jump pulse becomes effective at a time at which an armature on the scanner is not located centrally between the pole shoes of two electromagnets acting in different directions, then, according to the sense of the deviation from the central position—larger or smaller distance from the pole part of the electromagnet to be activated—a reduction or an increase in the force effect results.

According to a preferred embodiment of the invention, the spacing between the pole shoes of the electromagnet from each other as well as from the armature are arranged to be so large with regard to the largest positional change of the armature occurring in operation by radial or height variations in the surface of the record carrier that these positional changes have no substantial influence on the value of the magnetic forces between the pole shoes and armature.

The use of the invention is not restricted to record carriers carrying television signals but can also achieve a speeded up motion effect in audio recordings, in which the record carrier is played back with high rotational speed. This is of use for example for studio purposes.

The invention will now be described in greater detail, by way of example, with reference to the drawings, in which:—

Figure 1 shows a reproduction device for disc-form record carriers with television signals stored in grooves;

Figure 2 shows in side view an exemplary embodiment of a scanner for the reproduction device in accordance with the invention and the means for displacing the scanner transversely to the groove direction;

Figure 3 is a front view of the scanner shown in figure 2;

Figure 4 is a block circuit diagram of a control device for the scanning movement of the reproduction device;

Figure 5 is a further embodiment of a reproduction device with a piezo-ceramic element, in side view;

Figure 6 is an underneath plan view of the scanner shown in figure 5;

Figure 7 is a drawing of a record carrier, in the grooves of which are stored television pictures;

Figure 8 is a pulse diagram for the jump pulses showing the jump pulse sequences derived therefrom;

Figure 9 is a diagram of different reproduction examples;

Figure 10 is a block circuit diagram of a further embodiment of scanner control; and

Figure 11 shows a block circuit diagram of another embodiment of scanner control.

In the schematic drawing shown in Figure 1, a record carrier 1 is rotated over a fixed support surface 2 by means of a drive motor 3 and an entrainment means 4 which engage the central region of the record carrier. The record carrier 1 comprises a video disc having grooves containing stored television signals and rotates over an air cushion generated by air flow 5. A scanner, fastened on a sliding carriage 6 is positioned on the record carrier 1 for reproduction of the signals and is guided in the grooves on the record carrier 1 by the carriage 6 which is driven radially with respect to the record carrier 1 by means of a belt 7 and a second drive motor 8 through gear 9.

The scanner 10, together with a mechanical/electrical converter 11, is supported resiliently by means of a holder 12 on a carrier part 6a as shown in figure 2. The scanner 10 is in a position to follow height variations in the groove and lateral displacement of the record carrier 1 as a result of the elastic mounting.

In order to be able to search for individual parts of the record in the individual grooves

or in order also to repeat individual record parts in the cases of spiral shaped running grooves, the scanner 10 contacting the record carrier surface is provided with a device which makes it possible to displace it transversely to the groove direction by the application of force or jump pulses. In this case a jump transverse to the groove direction can be achieved by a corresponding choice of the force pulse components.

The lifting of the scanner may be achieved by means of an armature 13 connected to the scanner 10, two iron cores 14 and 15 connected to the mounting and forming an angle of in each case, 135° with the direction of the contact force, as well as pairs of coils pushed over these iron cores. The coils 16 and 17 are pushed over the iron core 14 and a similar pair of coils are pushed over the iron core 15 which is located, relative to the drawing of Figure 2, behind the iron core 14. One of these coils, 18, is shown in figure 3.

The V-shaped arrangement of the iron cores 14 and 15 can be seen from Figure 3 and, as a result of this arrangement, it is possible to displace the scanner on the disc in two different directions, thus into the preceding and following groove turns. Moreover on actuating the device, a force or jump pulse is applied a force component of which is opposed to the contact force acting on the scanner 10. In this way it is possible to lift the scanner from the surface of the record carrier to facilitate transverse displacement with respect to the groove direction by another component of the force or jump pulse so that the groove flanks are protected to a large extent. This arrangement can also serve to lift the scanner 10 from the record carrier 1 on termination of reproduction. The two pairs of coils are simultaneously controlled for this purpose by means of separate feed lines 31 and 32.

In order to ensure, during the return of the scanner 10 to the surface of the record carrier 1, protection of the disc material, the force pulses acting on the scanner 10 are so formed that the scanner is raised as rapidly as possible from the surface of the record carrier 1 but subsequently is lowered onto the latter as slowly as possible and without chatter.

In order to facilitate the change of a worn scanner, the carrier part 6*a* together with the holder 12 is releasably connected to a mounting 6*c*, which in turn is arranged fixedly on the sliding carriage 6 (figure 1). A catch 6*b* serves to hold the carrier part 6*a* in position. A plug connection 6d for the feed lines 31 and 32 also permits a simplified interchange of the pairs of coils together with the iron cores 14 and 15.

The magnetic gaps *c* and *a* respectively between the pole shoes 14*a* and 15*a* and 14*a* and 14*b* are made so large that the spacing changes occurring in operation remain practically without influence on the value of the magnetic forces. For this the gaps *a* in (Fig. 2) and *c* in (Fig. 3), as also the gaps b_1 and b_2 in Fig. 3, between the pole shoes 15*a* and 14*a* on the one hand and the armature 13 on the other hand can be dimensioned approximately ten times as large as any of the positional changes of the armature 13 from its average position, occurring in operation. If the components of these positional changes do not exceed approximately 0.05 mm in each gap direction, widths of the order of magnitude of 1.0 mm are sufficient for the gaps *a*, b_1, b_2 and *c*. In this way, the magnetic gaps of the actuating device should be dimensioned to produce an optimum force having regard to the amplitude of the jump of the scanner to be achieved and these gaps are preferably at least 0.8 mm. The gaps *a*, *c* and b_1 and b_2 are chosen to be substantially greater than the positional changes of the armature 13 occurring in operation in the directions of the force components acting in these magnetic gaps.

Figure 4 shows in block circuit diagram, the control means for displacing the scanner 10 transversely to the groove direction. A pulse generator 22 emits pulses which are synchronized by a signal at a frequency which corresponds with the record carrier rotation frequency, sensed by a sensor 23, and which are fed to two pulse sequence selectors 24 and 25. The pulse sequences which are necessary for the displacement of the scanner 10 and which also correspond with the rotational speed of the record carrier can be selected by these pulse sequence selectors 24 and 25. The pulse sequence at the output of the pulse sequence selector 25 is fed to an amplifier 26 to the output terminals 33 of which is connected the drive motor 8 for the scanner sliding carriage 6 in Figure 1. The drive motor 8 is a synchronous motor which moves the sliding carriage 6 with the holder 12 of the scanner 10 transversely to the groove direction at a speed adjusted to the pulse sequence selector 25. The frequency of the force pulses, which act on the scanner 10 and which cause a displacement of the scanner transversely to the groove direction, is determined by the pulse sequence selector 24. A phase controller 27 displaces the times of the pulses in such a manner that the lateral displacement of the scanner is undertaken during the reproduction of television pictures only during the vertical scanning times of the television picture so that the signal failure caused by the jump of the scanner does not appear disturbing for the viewer. For this a portion of the reproduced television signal is fed in at the input 28 of the phase controller 27 as the reference signal.

A pulse shaper 29 makes it possible to vary the intensity and the shape of the force pulses acting on the scanner. Moreover the relationship of the voltages applied at both pairs of

coils 16, 17 and 18, 19 and thus the movement direction of the scanner is variable. An amplifier part 30 is connected to the two coil pairs 16, 17 and 18, 19 by means of the connections 31 and 32.

Although the invention can be used for access to any signals stored in grooves of a disc-form record carrier in the form of coherent information blocks, it is particularly suitable for the reproduction of television signals. A disturbance-free television picture can be obtained in spite of the groove change of the scanner if the television picture signals are recorded in such a manner that like information parts, for example picture or line change pulses, are stored next to each other in adjoining or sequential grooves. This is the case in the reproduction of the television signals if a constant whole number of pictures or half-pictures is stored in a single groove turn.

The picture change is effected in a disturbance-free manner if the times of the jump of the scanner occur when signal portions, for example scanning pulses, which are not visible to the viewer, are transmitted. By a suitable association of the scanner feed speed and the force or jump pulses for the scanner the effects, known from cine film reproduction, such as slow motion, fast motion, still film and reverse projection can be achieved. In the case of still film picture reproduction for example the drive to the carriage 6 is stopped, while, at each rotation of the record carrier, the scanner receives a pulse to jump by one groove width transversely to the groove direction opposite to the direction of the groove pitch.

In the case of fast motion reproduction the feed speed is increased and simultaneously force or jump pulses in the direction of the groove pitch are imparted to the scanner. By increasing the pulse intensity it is possible to have the scanner jump over several grooves at each jump so that a fast motion effect by a large factor can be achieved.

A slow motion representation is produced by reducing the feed speed of the sliding carriage 6 and the scanner jumps back for the repetition of individual pictures. There thus exists a coupling of the jump movement of the scanner controlled by the force or jump pulses with a simultaneously actuated switch over within the feed drive to another speed—in the limiting case also zero speed —or reverse direction.

In order to protect individual grooves of the record carrier from excessive wear, it is appropriate in the case of the reproduction of a still picture after a certain time to suppress the spring-back pulse for the scanner necessary in the case of each rotation of the record carrier in order to have the scanner arrive in this way in an adjacent groove, which differs, in the case of conventional records, only slightly in its information content from the adjacent groove.

Figures 5 and 6 show a further embodiment of the invention which is simple to produce in which a carrier part 34 is connected fixedly with the sliding carriage 6 of the reproduction device shown in Figure 1. A piezo-ceramic element 36 is clamped to the carrier part 34 by means of a screw 35, which carrier part in turn serves as the mounting for a scanner 37 by means of a small holding tube 38 and the element 36. A damping ring 39 forms an additional support for the tube 38. The pulses to displace the scanner are produced by the piezo-ceramic element 36, which, as a result of an electrical voltage applied at the connections 40, is deformed and, in dependence on its polarity, effects a displacement of the scanner in one of the directions indicated by the arrows in Figure 6.

In the case of a reverse reproduction the scanner and the force pulses must be so selected that the scanner in the case of each jump jumps over, in each case, at least two grooves in a direction opposite to the groove forward pitch.

The invention can also be used particularly advantageously for teaching apparatus, since the didactical effect of the reproduction of still pictures often exceeds that of the reproduction of moved scenes. A very large number of pictures can be accommodated on the surface of a record carrier by the use of each individual groove for a different stationary picture.

It is moreover possible to dispense with the use of spiral-formed grooves, particularly for data storage or for storing individual pictures when it can be more advantageous to store information in concentric grooves, which are selected by adjusting the scanner transversely to the groove direction. The devices necessary for the displacement of the scanner in accordance with the invention can be inserted without difficulties in existing reproduction equipment since only the mounting of the scanner has to be changed in addition to a supplementation of the electrical control circuits.

Figure 7 shows a video disc as record carrier 1, from which the reproduction of the stored information is effected by means of pressure scanning. A spiral-shaped groove forms the record track, of which a few turns are indicated. In the case of the known video discs a spacing b_r of 3 to 5 μm between adjacent groove turns is usual. For the reproduction of a television picture, two half pictures are usually transmitted with completely identical picture content sequentially one after the other with half line staggering, and in the known video discs the signals corresponding to the half pictures are preferably so recorded that two half pictures are located in the length

of one groove turn. With this, the scanning gaps between the half pictures are arranged to lie on a common diameter of the video disc. Since two sequential half pictures have completely identical picture content, then in the case of still film pictures, slow motion or fast motion effects, care must be taken that the scanner 10 can be displaced only in the appropriately correct scanning gap (radius 20). If the jump takes place in the incorrect scanning gap (radius 21) then there results instead of an acceptable still film picture an individual stationary picture which however vibrates in itself. The vibration results because the scanner 10 is so displaced that it scans two sequential but not two completely identical half pictures.

A jump signal suitable for still picture reproduction for the scanner 10 can be derived from pulse signals indicating the speed of rotation of the record carrier 1. The force or jump pulses so energize the coil pairs that the scanner 10 is displaced from the end of a groove turn to its start—and thus back by a complete picture—by the armature 13. These force or jump pulses are shown in Figure 8 in row A. Instead of the still picrure reproduction also a "slow motion" reproduction can be achieved by every n th. force or jump pulse being suppressed, wherein n is a whole number. Then a force or jump pulse is given $(n-1)$ times, that is to say a complete picture is played back n—times. Since the n th. jump pulse is suppressed, the scanner 10 can follow a new groove winding, i.e. two further half picrures are repeated $(n-1)$ times. Rows B,C,D show pulse sequences for $n=2,3,$ n which corresponds to an extension of the reproduction time scale by twice, three times and n times. This "slow motion" reproduction similar to a slow motion effect is achieved if the scanner in each case is displaced back by one groove winding.

The force or jump pulses, however, can also be so formed that the scanner 10, on energization of the coil pairs by the armature 13 is displaceable by k times—k is any whole number—of the distance b_r between two adjacent grooves in a jump-like manner transversely to the groove direction. The sign of k in this case gives the jump direction. For negative k the scanner 10 is set back; if k is positive, the scanner 10 jumps forwards by k groove windings.

Figure 9 shows schematically a few reproduction examples for different values of n and k. A drawn-out line corresponds to the scanning of two identical half pictures which are stored in one groove winding, whereas the broken line arrow corresponds to the jump-like displacement of the scanner by one groove winding. The reproduction expanded by double the time scale of the recording is described by $n=2$, $k=-1$. For $n=\infty$ $k=-2$ a backwards reproduction results. In the case of $n=3$, $k=-2$ a pilgrim-step-like backwards reproduction takes place.

Instead of the "slow motion" reproduction also a fast motion effect can be achieved, the scanner jumping over at least two sequentially following half pictures, that is to say jumps forwards. Appropriately here no force or jump pulse is suppressed, but rather only the jump width is changed by k times the distance b_r. For $n=\infty$ and $k=1$ there thus results a time scale with a fast motion effect. If on jumping forward individual force or jump pulses were suppressed, then a certain periodic fast motion effect would take place, a few sections being speeded up, others on the other hand—in the case of suppressed force or jump pulses—would be reproduced with a time scale which is unchanged with respect to the record. Such a case is shown for $n=3$, $k=+2$. If $n=\infty$, $k\geqslant 0$ the time scale is speeded up by $(1/(k+1))$.

The speed of the sliding carriage 6 displaced forcibly by the feed motor 8 by means of the belt 7 must be controlled according to the desired reproduction time scale. In the case of reproduction with a time scale unchanged or expanded with respect to the record with $k=-1$, the feed motor 8, which e.g. can be a synchronous or a stepping motor is usually driven by the n th. pulses, in which in each case the scanning displacement is suppressed. In the reproduction with a time scale speed up with respect to the record, a control of the sliding carriage speed by pulses derived from the jump width of the scanner 10 is more appropriate. If the scanner 10 jumps by k times the distance b_r, then k pulses are fed to the feed motor. If in the case of fast motion effect not every force or jump pulse is suppressed, then $(n-1).k+n$ pulses per n pulses should be fed to the feed motor. In the case of a pilgrim step-like reverse reproduction, the jump width likewise goes into the feed speed.

In general the speed of the sliding carriage 6 displacing the scanner 10 transversely to the groove direction must be so selected that the holder 12 for the scanner 10 is on average in its mechanical zero position. Otherwise an undesired scanner jumping can occur, if the holder 12 is under a mechanical stress which is too large. For example a clean "slow motion" reproduction is impossible with the following setting: The scanner 10 jumps continuously $(k=-1)$, as is necessary for the still picture reproduction, but the speed of the forced feed is set in accordance with a desired time extension. For this case a still picture reproduction is obtained, i.e. the scanner plays back continuously only one groove winding. The scanner 10 however, is moved by the forced feed continuously in one direction. After some time there results, through the continuous deflection of the holder 12 from its mechanical zero position, a spring force

which allows the scanner 10 to jump over a few groove windings. Firstly again still picture reproduction results for the new position of the scanner 10. Now, arbitrarily forward switched individual pictures can be observed instead of a slow motion effect.

Figure 10 shows a block circuit diagram for a first embodiment of a scanning control for still pictures—or chronologically expanded reproduction. The reproduced frequency-modulated signals pass from the scanner 10 to a demodulator 56 and from there to a stage 92 for the further processing of the video signal. To produce the force or jump pulses for displacing the scanner 10, the main voltage coming from the mains terminal 61 by way of switch arms 62 and 63 is shaped in a pulse shaper 68 and its frequency is reduced in a frequency divider 69 to the rotating frequency of the record carried. The force or jump pulses thus produced pass through a further pulse shaper 70, a scanning stage 71, a phase shifter 27 and are so amplified in an amplifier 73 that they can be fed through adjustment resistances 74 and 75 to the pairs of terminals 31 and 32 in Figures 2 and 3. The pulse shape should be such that the scanner 10 is raised from a groove as rapidly as possible and is put down gently into one of the adjacent grooves. Therefore the pulses should, in each case, rise rapidly but drop away more slowly.

The scanning stage 71 is so controlled by the frequency divider 78, the dividing ratio n of which is adjustable, that each n th. jump pulse is suppressed and is not passed to the train 71—27—73—74—75—31—32.

The output signal of the frequency divider 78 moreover controls the feed motor 8 by means of the pulse shaper 79 and the amplifier 26.

A direct voltage motor 3*b* can also be used as drive motor 3 for the disc drive. In this case the motor 3*b* is fed from a direct voltage source through the terminal 65 and the switch arm 64. A pulse pick-up 66 coupled to the motor shaft emits a pulse corresponding to the mains frequency, e.g. 50 Hz, through the switch arm 62 to the above described electronic evaluation unit for controlling the scanner. The pulse pick-up 66 can, if necessary, be used for controlling the speed of the motor 3*b* by means of a suitable control module 85.

It is also possible to store the pulses for displacing the scanner and for controlling the scanner feed, together with the television signals on the record carrier. The recorded pulses, here, e.g. of one per record carrier rotation, are obtained after the demodulation in the demodulator 56 in a pulse separation unit 83 and fed through the switch 84 to the pulse shaper 70 and the frequency divider 78 and further processed in the way described above.

Figure 11 shows in a block circuit diagram one embodiment of a scanner control for $k=-1$ and in which n is adjustable by means of an operational type selector 98. A modulo-n-counter 96 counts pulses, the frequency of which is equal to double the mains frequency. A frequency divider 97, which lowers the frequency of an output signal from the counter 96 to one quarter is connected after this counter. The motor 8 of the forced feed can be controlled by the output signal of the frequency divider. A second modulo-n-counter 78 extracts from the jump pulses, the frequency of which is equal to the rotational frequency of the record carrier 1, every n th. jump pulse. The jump pulse sequence is so adjustable by a phase shifter 27 that the jumping of the scanner 10 can be effected in any position of the television picture. Preferably the jumping is designed to take place in a picture scanning gap. Moreover, the phase shifter 27 can ensure that the jump of the scanner 10 takes place at the end of the correct half picture. If the jump pulses are obtained by scanning the video disc, the phase shifter 27 can be set by the operator to a fixed value. Any adjustment of the equipment by the user is therefore not necessary. A pulse width former 93, symmetrizing element 94, amplifiers 30*a*,*b* and measuring device 95 serve for matching the jump pulses to the scanner 10 which can be displaced in a jump-like manner by the coil pairs, and the armature 13. The width of the jump pulses can be set by the pulse width former 93. The symmetrizing element 94 produces one jump pulse for each of the coil pairs. Moreover the width of the jump pulses for a control coil pair, e.g. 16, 17 can be reduced by the symmetrizing element 94, while the width of the jump pulses is simultaneously increased in the case of the other coil pair, or *vice versa*. In this way it is possible to compensate for any disturbing asymmetry of the jumping scanner, e.g. different inductances of the control coil pairs or a deviation of the scanner 10 from its centre position. This asymmetry can rest on the one hand on manufacturing tolerances and on the other hand can also be generated when playing back the video discs as a result of radial displacement. Moreover, the jump direction of the scanner 10 can be set by the symmetrizing element 94. This setting can be effected by means of monostable trigger stages (not shown) in the modules 93, 94, by adjustment of potentiometers. At the same time, the number k can be derived from the position of the potentiometers. The equalization of the disturbing asymmetry, which is generated by the radial displacement of the video disc, can take place automatically. For this the radial displacement can be measured either inductively or capacitatively with the help of a measurement device 95 and the scanning device, which comprises the control coil pairs and the scan-

ner 10 connected to the armature 13. A correction signal derived from these devices is fed to the symmetrizing element 94. The jump pulses thus obtained are amplified in the amplifiers 30a, 30b up to the desired pulse height and fed to the control coil pairs.

Although the device in accordance with the invention and the control circuits have been discussed only by reference to examples which refer to video discs, in which the reproduction is effected by pressure scanning, the device and control circuits can be used for reproduction equipment of general type, if the equipment contains a record carrier on which the information is stored in a spiral form track or in several concentric tracks. In the reproduction of television signals it is also possible by means of the invention, for example to displace, by a corresponding increase in the applied force pulses, the scanner for the repeat of short scene sections or for searching for certain points in each case over a large number of grooves.

Since the mounting of the scanner in each case is resilient, the force or jump pulses can also be produced so that, in the case of the scanner feed not coinciding with the normal feed, the restoring force, increasing during the following of the groove by the scanner, of the scanner holder is compensated. This compensation can, however, be disrurbed for a short time either by a force pulse overcoming the restoring force or by reducing the force necessary for the compensation of the restoring force until a jumping of the scanner has taken place. The last kind of force pulse production is used particularly for the jumping over of a plurality of groove turns, i.e. for so-called scene repetition.

WHAT WE CLAIM IS:—

1. A reproduction device for disc-form record carriers having signals stored in a plurality of grooves or in a groove having a plurality of turns, particularly for video disc-form record carriers, said device comprising a carriage which is displaceable during reproduction radially with respect to a record carrier and a scanner resiliently mounted on the carriage and guidable in said groove(s) in the record carrier, wherein means are provided to cause the scanner to jump at right angles to the groove direction into adjacent grooves or groove turns said means including a pulse generator arranged to act on the scanner with a force pulse which when energized serves to lift the scanner from the surface of the record carrier and to move the scanner radially with respect to the record carrier over a predetermined number of ridges formed between the adjacent grooves or groove turns in the record carrier.

2. A reproduction device according to claim 1, wherein the times of action of the force pulse generated by the pulse generator are correlated with the speed of rotation of the record carrier.

3. A reproduction device according to claim 2, wherein the pulse generator is triggered by signals contained in the signals recorded on the record carrier.

4. A reproduction device according to any one of the preceding claims, wherein means are provided for changing the intensity of the force pulse.

5. A reproduction device according to any one of the preceding claims, wherein said means for causing the scanner to jump include electromagnets which act on an armature connected to the resiliently mounted scanner.

6. A reproduction device according to claim 5, wherein two electromagnets are provided, each electromagnet comprising an iron core having a pair of pole shoes and wherein a coil is wound around each respective pole shoe.

7. A reproduction device according to claim 6, wherein the spacing of the pole shoes of on electromagnet from each other amounts to at least 0.8 mm.

8. A reproduction device according to claim 6 or claim 7, wherein the spacing between the pole shoe pairs of one electromagnet and the corresponding pole shoe pairs of the other electromagnet amounts to at least 1.0 mm.

9. A reproduction device according to any one of claims 6 to 8, wherein the spacing between the pole shoes and the armature amounts to 0.8 mm at its mean operational position.

10. A reproduction device according to any one of claims 5 to 9, wherein the scanner and armature are connected by a holder to a carrier which is releasably mounted on a mounting on which are located two electromagnets.

11. A reproduction device according to claim 10, wherein the mounting is constructed as a support into which the carrier can be pushed.

12. A reproduction device according to any one of claims 1 to 4, wherein the pulse generator comprises a piezo-ceramic element which is connected between the scanner and carriage.

13. A reproduction device according to any one of the preceding claims, wherein two pulse generators are provided which are controllable independently of each other and which supply force pulses in different directions within a plane located perpendicular to the groove direction.

14. A reproduction device according to claim 13, wherein the two pulse generators in each case form an angle of 135° with the direction of the contact force of the scanner acting on the record carrier.

15. A reproduction device according to any one of the preceding claims, wherein a pulse

shaper is provided which shapes the force pulses to have a fast rise time and a slow fall away time.

16. A reproduction device according to any one of the preceding claims, wherein means are provided for changing the sequence of the force pulses acting on the scanner.

17. A reproduction device according to any one of the preceding claims, wherein means are provided for generating force pulses whereby the scanner is displaced in a jump-like manner by the force pulses by k grooves of turns ($k = \pm 0,1,2,3,\ldots$) transversely to the track direction, that is to say for negative k radially outwards and for positive k radially inwards with respect to the surface of the record carrier and wherein a control circuit is provided for suppressing each n^{th} ($n=1,2,3,\ldots$) force pulse.

18. A reproduction device according to claim 17, wherein the scanner is displaceable transversely to the track direction by $((n-1).k+n)$ times the distance between adjacent grooves or turns over a period of n pulses.

19. A reproduction device according to claim 17 or claim 18, wherein at least one pulse sequence selector is provided for producing pulse sequences from the jump pulses, with which the movement of the scanner transversely to the track direction can be influenced, and wherein the control circuit includes a scanning stage for producing a first jump pulse sequence and a modulo-n-counter for suppressing each n^{th} jump pulse.

20. A reproduction device according to claim 19, wherein the jump pulses are sequentially displaceable by a monostable trigger stage in the form of a phase shifter, wherein the frequency of the force pulses is dividable by a second modulo-n-counter, after which is connected a frequency divider, and wherein the force pulses are controllable by the output of the frequency divider which emits a force pulse only in the case of a suppressed n^{th} jump pulse.

21. A reproduction device for recording of television signals according to claim 20, wherein the jump pulses are so displaced by the phase shifter that the scanner is displaceable in a jump-like manner only at the gaps between a signal sequence recorded on a record carrier.

22. A reproduction device according to any one of claims 19 to 21, wherein the record carrier is driven at a rotation frequency which is equal to half the mains frequency, wherein, from the mains frequency in a pulse shaper stage, feed pulses with l times ($l=2,3,4\ldots$) the main frequency can be produced for controlling the force pulses and wherein the frequency of the force pulses is equal to half the mains frequency.

23. A reproduction device according to any one of claims 19 to 22, wherein the or each modulo-n-counter can be adjusted by an operational type selector.

24. A reproduction device according to any one of the preceding claims, wherein the carriage is drivable by a synchronous motor.

25. A reproduction device according to any one of claims 1 to 23, wherein the carriage is drivable by a stepping motor.

26. A reproduction device according to any preceding claim, wherein the scanner is resiliently urged against the grooves or turns of a record carrier and wherein means are provided for compensating the resilient force.

27. A reproduction device for disc form record carriers substantially as described herein with reference to the drawings.

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4 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheet 1

FIG.1

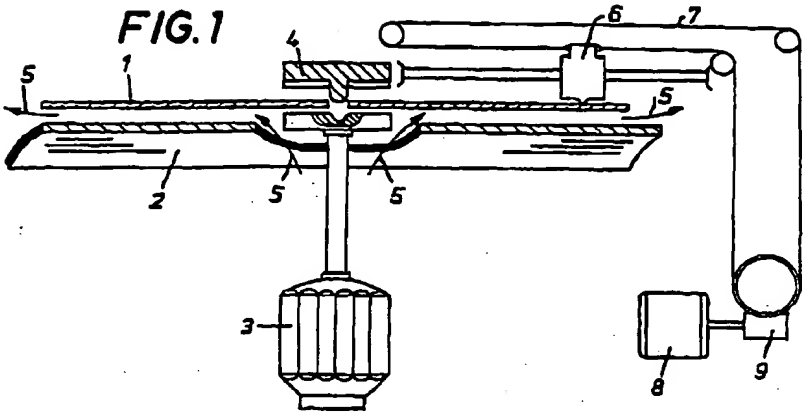

FIG.2

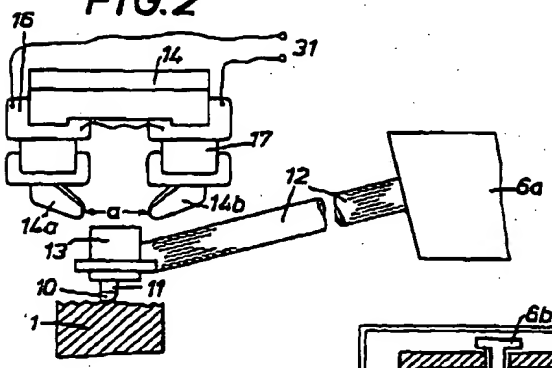

FIG.3

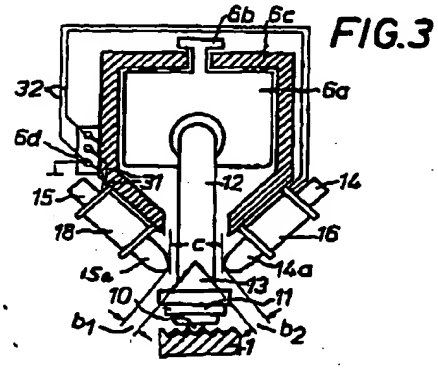

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FIG. 4

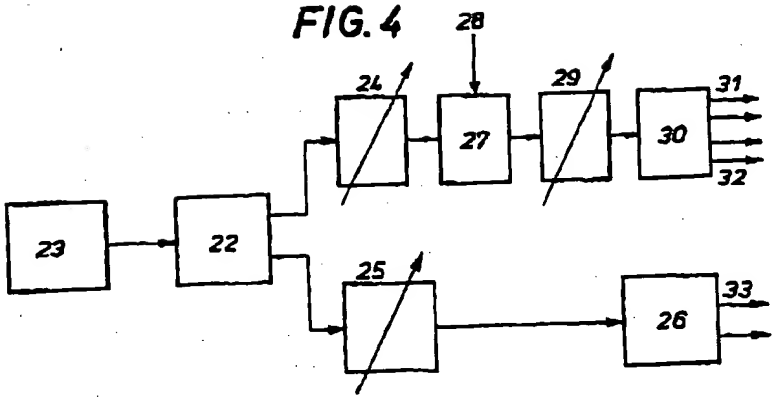

FIG. 5

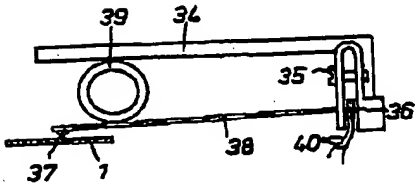

FIG. 6

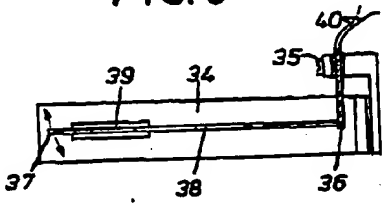

FIG.7

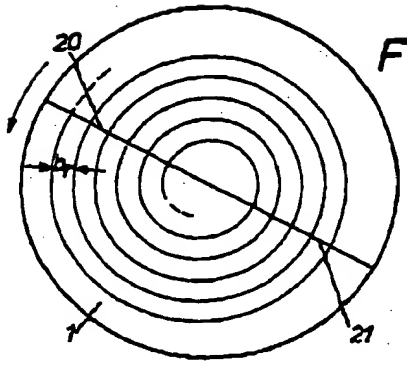

FIG.8

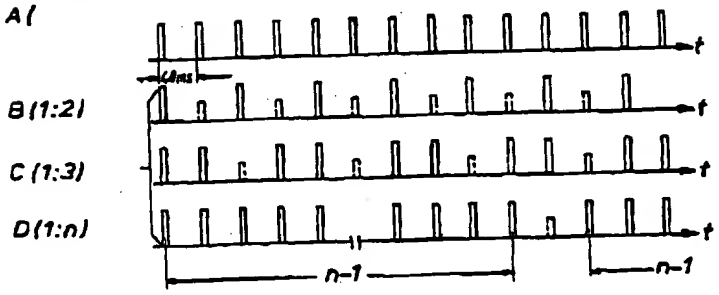

FIG.9

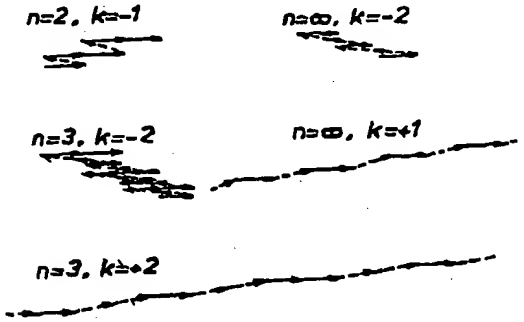

FIG.10

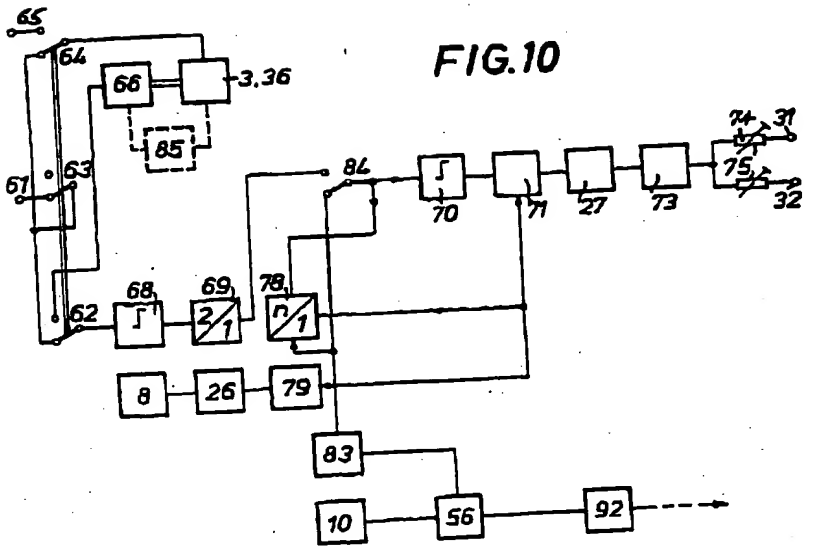
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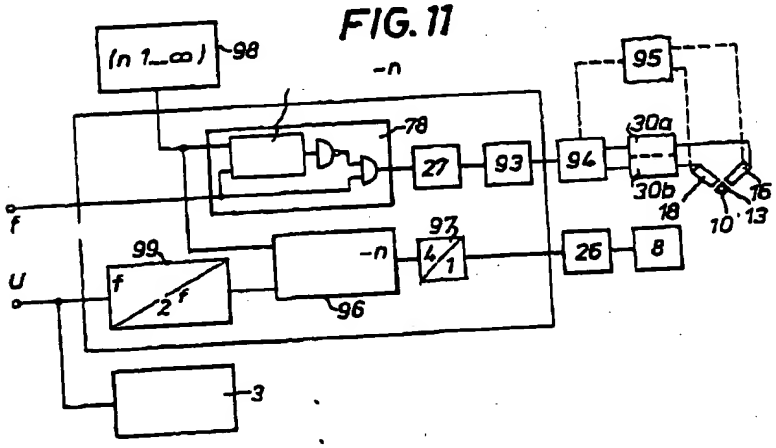
FIG.11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